Influence of the elasticity of the substrate on the genesis, propagation and coalescence of coatings and thin films buckling structures.

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Abstract: Thin films buckling is a scientific and industrial challenge of primary importance, since it corresponds to the first stage of the buckling of the film at a large scale, leading to the loss of the mechanical property initially conferred to the coated material.

The influence of the substrate elasticity on this phenomenon is not well understood today, whereas the proportion of industrial systems made of rigid films on soft substrates increase. This study focus principally on the influence of the substrate elasticity on the genesis, propagation and coalescence of the buckled structures. The experimental approach consists in the controlled generation of elementary buckling structures, such as straight-sided buckles, blisters or “telephone cords” buckles, to make them interact and even meet and merge each other. The morphological characterization of such buckling structures will be performed by the atomic force microscopy technique. These experimental results will be then compared to finite elements simulations performed together, allowing to take into account the coupling between the buckling of the film and the film/substrate interface delamination. The obtained results will allow a better understanding of the coating and thin film buckling phenomenon. Thus, this study answers in particular to three questions: how the substrate elasticity impacts the propagation dynamic of the buckles? How their crossing occurs, leading sometimes to complex structures? Is this elasticity helps the coalescence of the buckles, even if they do not match each other in a “ballistic” way?

Finally, the technological goal is part of an environmental approach that consist in identifying the parameters that can suppress, limit or control the buckling phenomenon for specific applications.